COUPLING FOR THE TEETH OF EXCAVATORS AND THE LIKE

SPECIFICATION

The present invention is intended to disclose a device for coupling excavator teeth of the type used on excavating machines and the like, that is to say, machines intended to remove masses of earth and stones in public and civil engineering works.

For the removal of masses of earth and stones in civil engineering works of all types, excavating machines of different types are traditionally used which comprise buckets equipped with working edges which are those intended to engage in the mass of earth and stones for their removal. For this reason, there are problems of accelerated wear of the cutting edge, which has to be provided with very hard, detachable members having a high mechanical strength which are the so-called "teeth". The said teeth are produced from materials having a high degree of hardness and mechanical strength, in order to obtain a more extended working life, and need to be exchanged easily, since their purpose is precisely that of bearing the wear of the working area, so that it is essential for their exchange to be easy and rapid.

The teeth for excavators and the like have to fulfil a series of conditions which in some cases are contradictory and which represent on the one hand reduced manufacturing costs given the type of application for which they are to be used and the frequency of their renewal, and on the other hand high strength and the most extended life possible.

The harmonization of this combination of characteristics is not easy in devices for coupling excavator teeth since, firstly, owing to the fact that they need to be low-cost mass-produced articles, it is not possible to have recourse to mechanization of the parts in order to obtain more or less narrow tolerances in their dimensions, so that it is necessary to carry out their manufacture on the basis of economical production

methods for obtaining solid parts, such as casting and forging However, the use of cast or forged parts represents an important limitation in the dimensional tolerances which can be obtained on the excavator teeth, resulting in limitations to good coupling between the tooth and the so-called tooth-carrier, which is the element for connection with the active edge of the bucket of the excavator. A result of the said unsatisfactory coupling is the occurrence of different operational problems due to incorrect fitting of the tooth in the tooth-carrier, which manifests itself in high local contact pressures with the consequent wear and increase in the coupling play between the tooth and the tooth-carrier, which in turn accelerates the problems of wear and leads to a reduction in the useful life of the coupling.

For the technical reasons mentioned above, one of the permanent problems in the manufacture of teeth for excavators lies in obtaining designs which make it possible to achieve improvements in the coupling of the tooth to the tooth-carrier without this meaning an excessive increase in the difficulties of manufacture and therefore in the cost of said parts. For this reason, numerous systems for coupling the tooth to the tooth-carrier have been disclosed, all of which claim to introduce improvements in the design of the parts and therefore in the coupling of the latter.

U.S. Patent 4.404.760 discloses a coupling with an adapter and a point element in which the adapter has a recess with ears and a nose portion which develop from a conical form to a free rectangular end.

The present invention has ears, which have a support function as they are capable of absorbing efforts transmitting the same from the end of the point to the adapter.

The coupling of the present invention is precisely the result of the work carried out by the inventors in order to obtain a more balanced solution to the technical problems which arise on the teeth of the

excavators. The result of the investigations and work performed by the inventors is that of obtaining a device for coupling excavator teeth which combines in a satisfactory manner the characteristics of mechanical robustness necessary in the part with significant ease of manufacture and with an extended life of the coupling.

According to the present invention, the satisfactory results thereof are obtained by means of a specific combination of elements for guiding and coupling the teeth in the tooth-carrier, which combination consists in: coupling by interposing special projections of the teeth which are equipped with a double, stepped internal guide, with complementary recesses of the tooth-carrier, mutual coupling in areas of revolution symmetrical to the coupling, and finally male/female coupling in a terminal prismatic area. The combination of these three types of principal coupling is obtained by producing a first area of coupling between tooth and tooth-carrier which comprises seatings which open on the edge of the tooth-carrier and which have internally a double straight guide which assumes the form of a profile which has in cross-section a double straight stepped region and which extends through the sides of the tooth-carrier parallel to the axis of the part. The tooth has projecting areas complementary to the said parts having a double stepped guide structure, so that, after their introduction, the aforesaid projecting areas are properly engaged in the double guide recesses, providing multiple areas of coupling between the tooth and the tooth-carrier in a transverse arrangement at 90° which provide a very effective coupling with many areas of contact between the two parts The immediate area of coupling between tooth and tooth-carrier has symmetrical revolution surfaces opposed to one another, assuming the form of areas of cylindrical or frustoconical surfaces, arranged on the start of the tooth coupling rod intended to coincide in the complementary opening of the tooth-carrier and, preferably, in an arrangement such that one of the revolution surfaces is arranged on

the upper portion of the part and the other, symmetrically opposed to the first, is arranged on the lower portion of the part. The third area of coupling between tooth and tooth-carrier, combined with those described above, constitutes a terminal journal of the coupling projection of the tooth, which assumes a prismatic structure with the edges rounded and the axis of which coincides with the axis of the part. The tooth has a coupling opening the structure of which is complementary to that of the tooth-carrier, there being obtained by means of the combination of the three separate areas of coupling which have been mentioned a very effective coupling between the tooth and the tooth-carrier which, without altering the favourable characteristics of manufacture by means of casting or forging, permits effective guiding of both parts with respect to each other, with the result that the areas of contact between tooth and tooth-carrier are significantly increased, which leads to less individual wear and therefore a more extended life of the coupling.

These improvements likewise provide for the arrangement of the seating of the bolt or cotter pin in the body or portion of the tooth-carrier which is not covered by the tooth, making it possible to increase the strength of the tooth-carrier, which in turn makes it possible to reduce the said tooth-carrier internally, reducing the weight of the assembly. The upper and lower ends of the seating for the retaining pin or bolt will optionally be closed by means of covers intended to preserve the seating of the cotter pin as far as possible, facilitating its subsequent disassembly at the right moment. The retaining bolt or pin will have a structure consisting of a base body carrying a centring extension which is joined to the base body by vulcanization. In order to permit the inspection of the correctly introduced state of the cotter pin and likewise certain manipulations which may be necessary for extraction, the tooth will have in one of its lateral fitting lugs an opening which coincides with the position of the bolt.

The constitution of the assembly of tooth and tooth-carrier may be symmetrical or asymmetrical with respect to the male and female lateral guides.

For greater understanding there are appended, by way of explanatory but non-limiting example, explanatory drawings of a preferred embodiment of the present invention.

Figures 1 and 2 show respective views in side elevation and in plan of a coupling for excavator teeth according to the present invention.

Figures 3 to 6 are cross-sections through the tooth coupling which correspond to the double, stepped guide area.

Figures 7 to 10 show cross-sections of the coupling area provided with revolution surfaces.

Figure 11 is a cross-section through the prismatic end journal of the coupling.

Figure 12 shows a plan view of the assembly of tooth and tooth-carrier according to the present invention, and Figures 13 and 14 show longitudinal sections according to the section planes indicated.

Figure 15 shows a view in side elevation of the assembly of tooth and tooth-carrier.

Figure 16 shows a section according to the section plane indicated in Figure 15.

Figure 17 shows a perspective view of the coupling device from the right-hand side corresponding to the cotter pin.

Figure 18 shows a perspective view similar to Figure 17 from the opposite side from the cotter pin.

Figure 19 shows a perspective view of an assembly of tooth and tooth-carrier according to the present invention.

Figure 20 shows a perspective view of the tooth which incorporates the coupling device of the present invention.

Figure 21 shows a side view in elevation of a variant of the tooth-carrier illustrated in Figure 1 and following figures.

Figures 22 to 27 are sections through the section planes indicated in Figure 21.

Figures 28 and 29 respectively show a longitudinal section through the assembly of tooth-carrier and tooth according to the variant in Figure 21.

Figures 30 and 31 are respective views in rear and front perspective of the tooth according to the present improvements.

Figures 32 and 33 show respective sections through bolts for retaining the tooth, according to the present improvements.

Figure 34 shows a view in side elevation of an alternative version of that shown in Figure 21, with asymmetric arrangement of the lateral guides.

Figures 35 to 40 are sections through the section planes indicated in Figure 34.

Figure 41 is a perspective view of the assembly formed by the tooth-carrier and tooth according to the variant in Figure 34.

Figure 42 shows a longitudinal section according to the section plane indicated in Figure 41.

Figure 43 shows a second longitudinal section through the section plane indicated in Figure 44, perpendicular to the section indicated in Figure 42.

Figure 44 shows a plan view of the assembly of tooth-carrier and tooth according to the present improvements.

Figure 45 shows a detail in section of the assembly of tooth and tooth-carrier according to the present invention, showing a variant of the edge where the tooth and tooth-carrier coincide.

Figure 46 shows a detail in section illustrating the stresses generated in the coupling in Figure 45.

According to the figures, the coupling device comprises firstly the tooth-carrying element designated generally by 1, carrying the male coupling which consists of an area 2 for coupling with the tooth and an area 3 for coupling with the active edge of the bucket of the excavator. The area 3 has a basically fork-shaped structure having arms 4 and 5 with a straightedged indentation 6 for coupling it to the active edge of the bucket by welding or other means. The projecting portion 3 has, as is customary in these coupling devices, a structure of decreasing section from the starting face 7 of the projection 2 to the terminal straight end 8. According to the present invention, the coupling 1 has on each of its sides respective openings 9 and 10 which start on the face 7 and which extend to the end 3 for coupling with the edge of the bucket, it being characteristic of the said openings that both have a structure based on a double internal guide by means of transverse straight steps, as will be seen in Figures 3 to 6, in which it will be observed that the openings 9 and 10 have rectilinear generatrices parallel to the axis of the part, assuming a form in cross-section in which there is constituted a double straight guide with intermediate step, having, for example, for the guide opening 9 the straight, parallel walls 11 and 12 of the first straight guide and the walls of the straight guide of the bottom of the indentation 9 which are indicated by 13 and 14. The straight guides of each side, for example 12 and 13, and also 11 and 14, are separated by respective straight steps 15 and 16. The structure of the indentation 10 is identical to that explained for the indentation 9, so that it will not be explained in greater detail. The provision of the double stepped guide improves the coupling between tooth and tooth-carrier by increasing the effective areas of contact between the two parts in the initial assembly. The tooth 17, Figures 15 and 16, has projecting lateral wings 18 and 19 of a shape complementary to that of the openings with double stepped guide 9 and 10, as can be seen in Figures 15 and 16, 19 and 20.

The coupling projection 2 has, after its start from the face 7 of the part 1, an area of coupling by means of revolution surfaces, which are formed by two surfaces 20 and 21, Figures 7 to 10, which may be constituted by frustoconical or cylindrical surfaces arranged in opposition to one another and symmetrical with respect to the axis of the part, which coincides with the axis of symmetry of the sections illustrated. The lateral grooves 22 and 23 extend along the said coupling area, ending in the most remote section illustrated in Figure 10, in which the two revolution surfaces opposed to each other, indicated in this case by 20' and 21', are practically joined by their ends. The third principal guiding area is formed by the rod 24 at the free end of the coupling area 2, which assumes a straight prismatic structure with rounded edges, as will be seen in Figure 11.

The coupling is completed by means of a transverse cotter pin 25 which is intended to retain the tooth 17 and which is housed in a transverse opening 26 which opens in the part 1 in the immediate vicinity of the face 7.

In the variant in Figure 21, indicated generally by 27, there can be seen a structure varying slightly in the rear extensions 28 and 29, the first of which represents a substantially obtuse-angled structure forming with the extension 29 an indentation at a certain angle with respect to the horizontal, intended for the incorporation of the tooth-carrier on the edge of a bucket or scoop of the earth-moving machine. In this variant the seating 30 for the bolt or cotter pin, which, as in the version in Figure 1, is provided in the body portion of the tooth-carrier and not in the part termed the "nose" 31, also has wide rebates 32 and 33 on its ends which, combined with a more reduced length of the bolt, as can be observed in Figures 28, 32 and 33, makes it possible to receive in the upper and lower portion respective covers 34 and 35 which preferably will be partially housed in the ends of the opening to receive the bolt 36. In

this way, additional protection is obtained for the ends of the bolt, which improves the protection of the latter against impacts from stones, metal objects and other elements which could cause its ejection, especially during demolition work, and additionally improving substantially the work of disassembling it for replacement. The bolt, as can be seen in the more detailed section of Figure 32, has a complex structure in which the body 36 is provided with a wide aperture in which is housed a centring insert 37 provided in its central portion of the outside edge with a small centring projection 38, and which is joined to the base body 36 by means of an area of vulcanized rubber 39, or some other resilient material.

The rectilinear construction of the bolt 36, which has been shown in Figure 32, may be modified in the form of a gently arched structure, as can be seen in Figure 33, in which is shown a bolt 40 provided with a certain longitudinal curvature, which is provided with a similar centring insert 41 with the central projection 42, and the union with a similar resilient area 43 being excepted.

The embodiment of the tooth-carrier with the seating for the bolt in the body thereof, instead of being located in the "nose" of the tooth-carrier, imparts greater mechanical strength to the latter and allows the tooth-carrier to be hollowed internally, as can be seen in Figures 22 to 26, in which can be seen the hollowing out 44, likewise visible in Figures 42 and 43, which opens in the area of coupling on the edge of the scoop or bucket, between the extensions 28 and 29. The said embodiment makes it possible to obtain greater lightness of the tooth-carrier assembly.

As can be observed in Figures 22 to 26, the variant of the tooth-carrier shown in Figure 21 has lateral centring grooves of symmetrical type 45 and 46, like the corresponding ones in Figure 1 and following figures, the version with double retaining bolt also being shown, the seatings 47 and 48 for the latter being seen in Figure 23

In Figures 28 and 29 can be seen the coupling of the tooth

49 in the tooth-carrier according to the variant in Figure 21.

On the tooth 49, Figures 30 and 31, can be observed the provision of the lugs 50 and 51 equipped with the upper and lower guides such as those indicated by 52 and 53 for the lug 50. The guiding of the lug 51 is effected simply by means of an internally projecting block 54 which substitutes the complete internal rib 55 of the variant of Figure 1, shown, for example, in Figure 20. At the same time, the lug 51 has an aperture 56 which will be at the height of the bolt and which makes it possible to observe the correct coupling of the latter and, if required, to assist with some manipulation from inside the said aperture in the event of problems arising with the extraction of the bolt.

In the sections in Figures 35 to 37 there can be observed the arrangement of asymmetric guide grooves, such as the single dovetail groove 57 at one side and the double stepped groove 58 on the opposite side, this constituting a variant that can be used in some cases as a substitute for the symmetrical groove on both sides of the tooth-carrier. In the case shown in Figure 36, there will also be observed the arrangement of a single cotter pin 59 associated with the double stepped groove 58.

The present invention likewise provides for a special constitution of the edge where the tooth-carrier and the tooth coincide, as can be seen in the figures and, in particular, in Figure 21 and in Figures 45 and 46. According to the present invention, the edge 60 of the tooth-carrier is not perpendicular to the median plane P of the tooth, but forms a certain angle α with respect to the perpendicular p as shown in Figure 45, the complementary edge of the tooth 61 having a corresponding shape so that it can make contact against the said edge 60 and by virtue of the angle indicated, the vector F_1 which represents the reaction of the stress of the force F exerted on the tooth when working can be broken down into the components F_{1Z} and F_{1Y} of which the latter

is a stress transverse to the median plane of the tooth, which therefore collaborates in maintaining the tooth coupled in the tooth-carrier, countering the effect of the component F_{1Z} which tends to eject the tooth and thus considerably reducing the risk of breakage through the mouth of the latter.

By means of the constitution which has been explained, the coupling for excavator teeth which is the subject of the present invention has demonstrated great effectiveness, since it permits secure coupling of the tooth in the tooth-carrier by ensuring multiple areas of contact in different planes for the distribution of the stresses on large surfaces for the purpose of reducing the wear in the coupling and increasing its useful life.